MEASURING THE SNOW LAYER IN MAPLE CREEK CANYON, UTAH.

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The third annual snow survey of Maple Creek Canyon has just been completed. It was successful in every way and added much to our knowledge of the storage of snow for irrigation and power purposes. The snow survey this year was conducted along the same lines as those of previous years. The various data which have been considered in making the estimates are: Snow depth, snow density or amount of water that the snow contains, whether snow is packed or loose, whether ground is frozen or otherwise, and whether wet or dry. All of the above factors are very important in making estimates, and experience is necessary to give each one its true weight.

The details of the survey are given below, and it is a summary made up of almost 1,500 soundings made by an alpenstock, and 281 measurements of snow density made by a piece of apparatus specially designed for the purpose.

The measurement of the depth and density of the snow layer over the Maple Creek watershed this spring reveals the fact that there is about 16 per cent more water stored in these hills than at the same time last year. It has also been found that the compactness of the snow is practically the same as it was last year, and that the ground beneath the snow contains no frost, as was the condition last year, so that if weather conditions from March 17, 1913, to the close of the irrigation season average about the same as in 1912 Maple Creek should supply about one-eighth more water this season than it did last year, and from a cursory examination of adjacent watersheds it is quite probable that the conditions in the Maple Creek watershed are an index to conditions in near-by mountains.

The snow at the time of the survey was about 5½ inches deeper than last year, and showed little drifting except in the rougher portions of the watershed; and up to the close of the measurement period there had been only a few small snow slides even in these regions, thus indicating a firm condition of the under layer. The streams were all comparatively low; the main canyon stream was closed by snow above Perry Hollow; Dibble Canyon was closed from a very short distance above the falls, and the stream from Right Hand Fork was small and extended but a few rods from its junction with the main canyon stream.

Practically the entire watershed carried a snow covering of a trace or more, excepting the north side of the main canyon which was generally bare. It was also discovered that a comparatively small acreage, confined to a few slopes, carried so little as a trace, or broken covering, of snow. The density measurements, or determinations of the actual water content of the snow, showed noticeable uniformity throughout the regions measured.

Owing largely to the impracticability of securing measurements of the snow that will be comparable from year to year in the rougher portions of the watershed and on the steeper slopes, no systematic measurements were made this spring in Right Hand Fork, nor in Maple Canyon slide and Service Berry Hollow. It is therefore believed that in the figures herewith presented of the snow layer over the smoother portions of the watershed, we have records that represent very closely a measure of the amount and condition of the snow that will form a basis for fairly accurate comparisons with measurements in other years. The comparisons made in the accompanying table may be considered direct, as the averages and values for identical regions have been computed for this purpose. In comparing the 1913 and 1912 figures with the values obtained in 1911, however, it will not be forgotten that these last named figures were obtained two weeks later in the season.

COMPARATIVE SUMMARIES OF MAPLE CREEK SNOW MEASUREMENTS MADE DURING THE PAST THREE YEARS.

	Year.	Month and date.	Number of measurements.	Average depth of snow.	Average amount of water in the snow, inches.	Percentage of density.
Perry and Squaw Hollows	1911	Mar. 22	18	23.1	7.4	32
	1912	Mar. 5	36	37.2	9.6	26
	1913	Mar. 6	36	41.9	9.9	24
Tuckett Hollow	1911	Mar. 23	27	35.3	11.8	33
	1912	Mar. 6	29	46.2	13.0	28
	1913	Mar. 7	38	48.0	11.6	24
Left Hand Fork and all its south and southwest branches	1911	Mar. 24, 25	76	36.7	10.1	28
	1912	Mar. 8, 9	66	46.8	10.2	22
	1913	Mar. 9, 10	94	51.7	12.8	25
Dibble Fork and its left-hand branch	1911	Mar. 26, 27	65	38.7	13.4	35
	1912	Mar. 8, 9	91	45.6	11.5	25
	1913	Mar. 10, 11, 15, 16.	85	50.8	12.7	25
Main Maple Canyon and Van Leuvan Hollow	1911	Mar. 27	9	27.3	8.3	30
	1912	Mar. 11, 13	44	29.6	6.4	22
	1913	Mar. 12, 13	28	32.9	8.3	25
Summary, entire region	1911	March, last half.	195	35.4	10.8	31
	1912	March, first half.	266	42.2	10.2	24
	1913	.....do	281	47.8	11.8	25

A number of small excavations into the soil beneath the snow were made at various places over the region traversed. The earth was found to be quite moist, even on the steep slopes, with a temperature of about 33° at depths from 4 to 10 inches beneath the soil surface. The temperature of the snow near the soil was 32°.

An interesting fact in this connection is that many of the streams which appear suddenly from beneath the snow in the creek bottoms, where the open streams begin, and those that come from perpetual springs out of the hillsides, have temperatures much higher than the surface soil temperatures observed. The temperature of the water, fresh from the earth, near Perry Hollow at an elevation of about 7,000 feet was 43°, and moss was clinging to the few rocks there, and a few blades of grass were growing in a midstream patch of soil. About one-half mile farther down stream permanent spring from the canyon side showed a temperature of 44°, and moss and watercress were profuse there with quite a quantity of ordinary grass as well. A large spring at the outlet of the canyon about 2,000 feet lower, and about 3 miles farther downstream has a temperature of 48°. The temperature of this spring had been observed by its owner many times, and it is said not to vary even a fraction of a degree from winter to summer. It is said by those acquainted with the upcanyon springs, that their temperature does not appear to vary from season to season, and they are always colder than the spring at a lower elevation.

SNOW SURVEY IN THE WALKER DRAINAGE BASIN, NEVADA.

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On March 19, 1913, the writer, in company with Messrs. Charles Fulton and J. L. Edmiston, began a snow survey of the Walker Drainage Basin. Prof. Church's snow sampler was used and worked excellently. A cutter where the sampler pierces the snow was battered in 11 days work, and was replaced by a new one. The sam-

pler has a scale on its side by which the depth of snow can be read. It also has little slots along the side through which the core of snow can be seen moving upward nearly even with the top of the snow, and if any of the snow core is lost in raising it out of the snow it can be detected immediately and a new sample taken before weighing. The spring balance used for weighing gives the inches of water contained in the snow direct. This balance is fitted with a milled pinion for setting the dial to the zero point when the empty sampler is placed on the balance. The scale reads to one-half inches, but tenths may be estimated.

The first day we went to Twin Lakes and established a base of supplies, taking 20 measurements on the way. The writer took the team back to Bridgeport that night. On the second day Messrs. Fulton and Edmiston made an attempt to take measurements in Cattle Canyon, but could only go to the 9,000-foot level, the wind making it very dangerous. The remainder of the day they worked at lower levels south of Twin Lakes. The third day they took measurements up Robinson Creek to the 8,000-foot level. The fourth day they went up the slope south of Buckeye Creek to an elevation of 8,000 feet. On the fifth day they went to Blackburns, stopping at Fales as they went, and taking measurements up to 8,000 feet. The sixth day they went west from Blackburns to Sonora Bridge, at an elevation of 8,000 feet, and down the north slope.

The weather was unfavorable during the entire trip, and interfered with work at lower levels as well as preventing measurements above the 9,000-foot level. If fair weather had prevailed, many measurements could have been taken at higher levels and better work done at lower levels.

The watershed was then divided into courses for every 1,000 feet, and each course divided according to direction, north, northeast, east, etc. The data pertaining to each of these areas were then tabulated and the averages obtained and are shown in Table 1. No measurements were taken in this basin above the 9,000-foot level, so measurements at or near the 9,000-foot level in this basin and some measurements at or above 9,000 feet in the Carson Basin were used in interpolating depths for 9,000 feet or higher. Four measurements in Table 2 were omitted and one scaled down because they were from so few measurements that they were unreliable, and were on slopes where there was known to be very little snow.

By using a card scale and a contour map it was found that there are about 105,600 acres in the Walker Basin at an elevation of 6,000 feet to 7,000 feet; 131,200 acres from 7,000 feet to 8,000 feet; 165,120 acres from 8,000 feet to 9,000 feet, and 176,640 acres above 9,000 feet. One-eighth of each of these areas would be about the portion sloping each direction. The number of acres in each slope for each 1,000 feet was multiplied by the number of inches of water on that slope at the same level, giving the number of acre-inches. The results are tabulated in Table 2.

A survey was also made in the Carson Drainage Basin, but not enough measurements were taken to give very accurate results. Some very interesting features were brought out, however. Two measurements were taken in drifts at the 9,000-foot level; the snow in one was 174 inches deep, the other 164 inches deep; the water equivalent in the one was 80 inches deep, the other 63 inches. Quite a number of measurements were taken about 9,000 feet and as high as 9,500 feet; the average, not including the two drifts, was 47 inches of water.

In starting the snow surveys it was necessary to ride through the mountains about 250 miles, and it was noticed that there was a great deal of snow on the north, northeast, and east sides of the mountains, and that there was scarcely any snow on the south, southwest, and west slopes. It was also noticed that a slope in a given direction would have about the same amount of snow that a slope in the same direction and of the same grade at the same altitude would have in another portion of the mountains.

A great deal of time was spent in studying the data obtained, in connection with the things noticed in riding through the mountains, and in discussing the plan with mountaineers, with the professors who are carrying on experiments in the mountains, and with engineers who are trying to determine how much water can be obtained for irrigation purposes. It is thought that it is useless to try to discuss data from the 6,000-foot to 7,000-foot level in connection with data from 9,000 feet or above; also to try to discuss data from a northeast slope in connection with a southwest slope. Therefore it is thought the following table, or something similar should be followed in preparing the data for study.

TABLE 1.—*Average depth of water equivalent in snow, Walker Basin, Nev., for the several slopes.*

	N.	NE.	E.	SE.	S.	SW.	W.	NW.
6,000 to 7,000 feet	6.6	4.0	3.5	.....	.....	.....	.....	.....
7,000 to 8,000 feet	10.5	8.3	3.9	5.3	2.0	.....	1.8	5.9
8,000 to 9,000 feet	11.0	17.3	9.0	6.2	.....	1.0	1.2	11.1
Average	9.4	9.9	5.5	3.8	.7	.3	1.0	5.7

TABLE 2.—*Water equivalent in snow, Walker Basin.*

Acres.	Depth.	Acre-inches.	Acre-feet.
6,000 to 7,000 feet:	*Inches.*		
N. 13,200	6.6	87,120	.....
NE. 13,200	4.0	52,800	.....
E. 13,200	3.5	46,200	.....
SE. 13,200	.....	.....	.....
S. 13,200	.....	.....	.....
SW. 13,200	.....	.....	.....
W. 13,200	.....	.....	.....
NW. 13,200	.....	.....	15,510
7,000 to 8,000 feet:			
N. 16,400	10.5	172,200	.....
NE. 16,400	8.3	112,120	.....
E. 16,400	3.9	63,960	.....
SE. 16,400	2.0	32,800	.....
S. 16,400	.....	.....	.....
SW. 16,400	.....	.....	.....
W. 16,400	1.8	29,520	.....
NW. 16,400	5.9	96,760	42,280
8,000 to 9,000 feet:			
N. 20,640	11.0	227,040	.....
NE. 20,640	17.3	357,072	.....
E. 20,640	9.0	185,760	.....
SE. 20,640	6.2	127,968	.....
S. 20,640	.....	.....	.....
SW. 20,640	.....	.....	.....
W. 20,640	1.2	24,768	.....
NW. 20,640	11.1	229,104	95,976
9,000 feet or more:			
N. 22,080	44.6	984,768	.....
NE. 22,080	47.0	1,037,760	.....
E. 22,080	26.1	576,288	.....
SE. 22,080	18.2	401,856	.....
S. 22,080	.....	.....	.....
SW. 22,080	.....	.....	.....
W. 22,080	4.7	103,776	.....
NW. 22,080	27.1	598,360	308,567
Total	.....	.....	462,333